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WELL PAVED STREETS.

THEIR . . . . .

IMPORTANCE, ECONOMY, MATERIALS AND ADMINISTRATION.

BY . . . .

J. W. HOWARD.

AN : ADDRESS : AT : THE : JOINT : CONFERENCE : ON : MUNICIPAL : GOVERNMENT AND : IMPROVEMENT. : : : : :

. . . MAY 10TH, 1894.

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WELL-PAVED STREETS.

BY

MAJ. J. W. HOWARD, C. E.

IMPORTANCE OF PAVEMENTS.

Transportation, affecting as it does the welfare of every human being, is a subject which deserves careful attention. Modern civilization owes a great debt to improved transportation, which has drawn men closer together and enabled them to easily interchange materials and ideas and to live nobler, more peaceful and more prosperous lives.

Inter-communication between nations and parts of nations has been steadily improved, from simple paths to wagon roads, at first poor and almost impassable, and then thanks to the labors of Tresagnet, Haussmann, Alphand, de Tavernier in France; Macadam, Telford and Haywood in England; Gilmore and others in America, it is possible to construct roads and pavements which are firm and solid at all times.

As the railways and roads are the arteries of travel and transportation in the country, so are the streets the arteries within the city.

The streets of cities are the great termini of the network of roads and railways over a nation.

The great railway stations of London, Berlin, New York or Philadelphia show that the terminus question is very important, and often a far more difficult problem than the railway itself.

The transportation of passengers over the Brooklyn Bridge has become one of how to receive and disembark them at the termini of the Bridge, a problem not yet solved.

No subject is more deserving of attention and study than the streets of cities and their equipment. Few persons who daily pass along the streets of cities realize that the "paving problem" is one which is not yet fully solved. The problem of how to pave and maintain its streets constantly perplexes the mental and financial resources of every community.

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A city is a living being which, once founded, will grow, improve, become strong, wealthy, permanent, prosperous and contented, or the reverse of all this, as it gives attention or not to its moral, mental and material welfare.

The health, wealth, peace, prosperity and real success of a city depend as much, if not more, upon its engineers and builders as upon its merchants, law makers and teachers.

GOOD PAVEMENTS ESSENTIAL TO PROSPERITY.

Although some cities, because of their location or other natural advantages, seem successful, nevertheless they are not so in the broadest sense. The crowded, narrow, unattractive and unwholesome streets, surfaced with pavements which are the harbingers of disease; absorbing, developing and giving off myriads of germs, so destructive to human life, and so fatal to the dense population cramped along and adjacent to such streets, demonstrate how far short of true prosperity and perfection such cities still are.

DIVISION OF THE SUBJECT.

Every street must be provided with a surface or covering suitable for the passage of vehicles, foot travel, other uses and requirements. The portion of this covering which is upon the roadway is called the roadway pavement, or simply the pavement. The portion on the foot path is called the sidewalk.

SIDEWALKS.

I will dwell only briefly on the subject of sidewalks, because they can be constructed upon several methods giving practical satisfaction.

The curbstone between the roadway of a street and the sidewalk should be so firmly set that it cannot be displaced by blows from vehicles or by the frost. It is not economical to retain poor, weak or broken curbstones when a street is paved or a sidewalk laid.

All sidewalks should be laid upon a suitable foundation or supports, so as not to be displaced by ordinary use, water or frost. Handsome, durable sidewalks are of great value to the adjacent property and to the entire city. I strongly advocate the prompt laying and maintaining of sidewalks under specifications, orders and control of the city authorities, charging the expense, if necessary, at cost to adjacent property.

GENERAL STREET EQUIPMENTS.

A street surface consists of much more than simply the roadway pavement and sidewalk. Upon certain streets and

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avenues where provision is made for light, air, comfort and beauty, we find grass plots, flower beds and other necessities of modern civilization.

We also find upon or above the streets many agreeable and necessary arrangements, as well as many things which custom permits or selfishness forces upon us. It is not the province of this paper to discuss lamp, electric light and other posts, which in many places could be advantageously replaced by handsome brackets from the houses, as in some streets of foreign cities. Letter boxes, fire alarm and police boxes, water hydrants, telegraph, trolley and other poles, and necessary or temporary adjuncts of a street equipment, could often be much better placed.

Benches are not out of place at carefully chosen spots along avenues, which are well paved and equipped with handsome sidewalks, as at Paris, where the streets are so fully equipped and beautified, that almost the entire population takes pleasure in remaining out of doors during a large part of its leisure, to its great advantage and to the admiration of thousands of Americans who visit that city.

Many people from all countries remain permanently in Paris after having retired from business life.

It is true political economy for a city to make its streets and pavements so attractive, that retired, successful merchants and others will remain within the city, or come to it after withdrawing from the active affairs of life. Too many American cities repel successful and retired men and women, because of their unattractive, rough, noisy, dirty and poor street pavements and all that accompanies them.

Washington obtains some of its best permanent citizens from other cities because of its handsome streets and parks.

PROGRESS.

Great progress has been made in many cities of the United States during the past eighteen years. Improvements inaugurated in Washington and elsewhere have spread to many other cities. Within the past six years they have entered New York City, so that we begin to feel that its streets are being redeemed. They begin to cease to be a byword for each arriving European immigrant.

ENCOURAGEMENT.

Nothing encourages this work of improvement more than that a body of men and women such as have inaugurated and are connected with this series of conferences

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should take up the problems involved, and study how to make our surroundings more agreeable, healthful and profitable; how to increase the earning power of the citizens; how to remove the injury to business caused by poor pavements.

These people, by studying the health and progress of the community, realized how much depends upon the equipment and condition of our streets, and arranged for an entire evening to be given to this subject. I could not have been more highly honored than by being chosen to try to present a few thoughts upon well paved streets.

INFORMATION NEEDED.

Great improvements in lighting and draining the streets of American cities have been made. The paving, maintaining and cleaning of the streets of cities have too often been entrusted to inefficient men, men lacking long, careful and special training, men who have been unwilling or unable, generally because of causes beyond their control, to investigate, inspect, tabulate and profit by the experience of their own and other cities. One or more persons in charge of the pavements of a city should personally inspect and study the methods by which Paris, Berlin and portions of London as well as Washington and Buffalo are so well paved, maintained and cleaned. The public of our cities should thoroughly understand that, while in other matters we have superior equipments to those of Europe, in pavements we are, on the whole, as yet inferior.

TRAINED MEN NEEDED.

City after city, like Washington, New York and others, after long struggle, much patience, strong opposition and costly experiments, have taken water-works, sewers, pavements and other public work out of the hands of men who are ignorant or apathetic or who follow only local traditions and methods.

Our cities are gradually placing these matters in the hands of men who apply scientific means and methods and who use the results of the combined experience of many cities for many years. Their work does credit to our cities, to the men who direct the actual paving and to the city officials, mayors, or others who sustain them in their efforts to compel the work to be done as ordered. The contractors and companies which are now laying the best classes of asphalt and granite pavements upon durable foundations, conscientiously and well, are doing credit to themselves and to the cities employing them.

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VALUE OF STATISTICS.

Our cities generally lack tabulated and analyzed statistics covering past experience in paving as well as other matters. This makes the work of city officials difficult, deprived as they are of the experience of their predecessors. The short terms of office of city engineers and those in charge of the pavements make tabulated experience all the more necessary.

More than enough money is wasted by injudicious use and repetition of poor methods, through ignorance, in many American cities, than is needed to pay an expert statistician, who would save his salary and thousands of dollars besides. He would prevent recurring expense, inconvenience, annoyance and injury to the city and citizens.

Records of pavements should be analyzed and tabulated upon a basis of the square yard, which has become the unit of measurement for street surfaces. The cost of first construction, materials, labor, repairs or maintenance, and administration or superintendence should be distributed by the square yard, kinds of pavements, etc. The traffic passing over the pavements should be counted, recorded and reduced to quantity or tons per square yard per day. The cost of cleaning pavements should be reduced to the same basis. If interest upon the cost of pavements is combined with all other expenditures (the pavements being kept in constant good repair), our cities would know within fifteen years exactly what pavements are to their best interests.

If, perchance, any official thinks to retain his office because he makes his experience a private matter, he is mistaken. No matter how honestly he may account for money expended he will be a failure. A single official has such a short life compared with the life of the constructions in his charge, that his personal experience counts for little. It is a crime to be entrusted with a public matter and not make it a public experience. Such an official cannot be measured and compared with others by definite standard, tabulated results. If he accomplishes much, the fact cannot be fully demonstrated, and he reap the benefit.

New York and other cities are now giving closer attention to recording past experience and adding to the same.

ROADWAY PAVEMENT AND PROBLEMS INVOLVED.

The roadway pavement of a street must meet many requirements. A pavement is a structure built one way by ignorant or unprincipled men, and built another way by trained and conscientious men. The pavements of our

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cities tend to smoother and more even surfaces. Materials are now used and so put together that proper repair and maintenance are possible. A pavement is a plant which should be maintained up to its original value by constant supervision and repair. If a pavement is neglected until it must be replaced, this replacement is maintenance all in a lump. It would have been far cheaper, and better for all concerned, if the original pavement had been kept in constant repair. The policy of every city should be, as in most large European and a few American cities, to consider its pavements from the standpoint of efficiency as well as cost.

The city which studies how to make itself more agreeable; business more prosperous; how to increase its earning power; how to remove the costly check on business caused by the need of extra horses to haul loads over rough pavements; how to reduce the cost of repairs to pavements, vehicles and harness; how to facilitate and make possible perfect street cleaning and suppress the cost of sprinkling; in fine, how to improve the health, success and contentment of a city—the city which studies these problems discovers how much depends upon street pavements.

DEFINITION OF A PERFECT PAVEMENT.

As a standard with which to compare pavements, a definition of a theoretically perfect pavement is needed.

A perfect street pavement would provide a surface for the easy passage of vehicles of the classes to be provided for in different sections of a city. It would offer the least resistance to traction consistent with a foothold for horses. It would be easily cleaned, be impervious to moisture, retain no filth within it, produce from itself no odor nor dust, be as noiseless as possible, and be otherwise of sanitary value. It would suppress jarring, not only of vehicles passing over it, but also of adjacent buildings. It would be as durable as is consistent with being kept in continual repair. It would admit of quick and easy repairs. It would permit being cut through and firmly renewed over gas and other pipes. It would be so laid as to be easily and quickly drained. It would permit being crossed on foot at any point.

All pavements should approximate as closely as possible to the foregoing requirements. Local and other special reasons often permit or compel a departure from what would be the best pavement. The best pavements, however, should be kept constantly in mind, and the temporary or

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poorer ones gradually be made to give way to their introduction.

DIRECT AND INDIRECT EXPENSES DUE TO PAVEMENTS.

The question of cost of pavements is a relative one. Pavements must be had. A city without pavements could not preserve its existence. We must not compare pavements simply by first costs and durability without repairs, etc. True economy in paving dictates that we should consider not only the first cost, but also the cost of maintenance, renewals, cleaning, sprinkling; also give due thought to the indirect private expenses of citizens depending upon the cost of traction or transportation; also study the cost of repairs to vehicles, harness, the number of horses needed, the wear on horses, weight of loads, the effects of dry, wet, hot and cold weather, and the dust from the street which affects our health, clothing, furniture and goods. It is true economy to consider the convenience, comfort and needs of the people using and living near our street pavements.

CONSTRUCTION OF PAVEMENTS.

The next division of the subject which I will briefly outline is that of the materials of pavements and how they are used. I have been requested to avoid technicalities in this address. It certainly is the tendency of engineers to be too dry and technical. It is said that people dislike plain facts. I know they dislike statistics. In trying to avoid technicalities, facts and statistics, the three favorites of engineers, I will run the risk, with your indulgence, of the other extreme.

FOUNDATIONS OF PAVEMENTS.

Foundations are needed for pavements as for other structures. A pavement without a durable foundation will soon fail. These foundations in the interior of a city should be some form of concrete, which is a mass about six inches thick of crushed stone or clean gravel, cemented together with a mortar composed of hydraulic cement and sand. Other foundations are made from crushed stone held together by an asphaltic or thick bituminous cement or pitch. Old stone-block, cobble-stone, telford, macadam and gravel roadways are often used for a foundation by covering them with an asphaltic or bituminous concrete about one and a half inches thick.

WEARING SURFACE OF PAVEMENTS.

The "wearing surface" is next placed upon the prepared foundation. This wearing surface is what is generally re-

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ferred to by the public as the pavement, whereas the whole structure is the pavement. The wearing surface of asphalt, stone or other material, is placed there to bear the wear of the traffic. It should be a material which can be kept with slight attention in good condition.

MATERIAL USED.

The materials used with varying good and poor success for pavement wearing surfaces, arranged alphabetically, are as follows: *Asphalt* of various kinds and qualities; *asphalt blocks; asphalt imitations; basalt blocks; boulder stones; bricks* of various kinds and shapes; *coal-tar imitations* and adulterations of asphalt; *cobble-stone; dolerite blocks; granite blocks; limestone blocks; sandstone blocks; scoria* or slag blocks; *syenite blocks; trap blocks* and *wooden blocks.*

I omit the materials of telford and macadam roadways, for these are not properly classed as pavements, belonging as they do to the suburbs of cities and to country roads. If used within a city and under heavy traffic, macadam and telford roads are ruinously expensive because of the cost of almost daily renewals. They are unsanitary and unsatisfactory. They belong to parks, certain reserved drives and the suburbs, where they are highly appreciated.

POOR PAVING MATERIALS.

I will not intrude upon your patience by reviewing, *in extenso*, the materials which have proven unsatisfactory for pavements of the larger cities. It suffices to enumerate them and give the principal reasons for avoiding their use.

Cobble or boulder stones make worthless pavements; they are noisy, uneven, unsightly and unhealthy. They were abandoned in Europe almost a century ago. Macaulay in his history describes how they were of great financial and sanitary injury to London. Strange to say some parts of Brooklyn and a very few other cities still indulge in this barbarous street covering.

Sandstone and *limestone blocks* become quickly rounded or disintegrate and are worthless for good paving in any city.

Dolerite, called also *basalt* and *trap blocks*, are not suited for paving where granite or syenite blocks can be obtained. Trap rock has no true cleavage and breaks irregularly. Paving blocks made from it are irregular and make an uneven pavement. The blocks of a trap rock pavement slowly become rounded and polished. A trap block pavement is almost as objectionable as one of cobble-stones.

There is a general class of pavements which we may call *artificial block* pavements. These blocks are of *wood*, crushed

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stone, cemented together with a bituminous substance, and called *asphalt blocks*, *bricks* of clay, slag and other materials. All these artificial blocks, except under very favorable conditions, have been failures, and have no place on well paved streets of great cities.

Paving bricks and *asphalt blocks* may be used under very light traffic with some success. Increasing traffic necessitates oft repeated renewals; so much so, that wearing surfaces of these materials, if kept in repair, gradually become ruinously expensive.

The other materials which must be avoided in paving the thoroughfares of cities are *coal* or *gas-tar* adulterations and combinations. They have been used in laying imitation asphalt pavements. Experience and statistics accessible to every municipal engineer should enable him to withstand the efforts of unprincipled or ignorant persons, to again lay these materials on the streets of any city.

GOOD PAVING MATERIALS.

The successful materials for wearing surfaces, and which approximate most closely to the requirements of the definition of a perfect pavement, are *natural asphaltum* compounded with sand and other materials and applied in various ways; and *natural stone* of several kinds and forms.

STONE BLOCK PAVEMENTS.

Granite and certain granitoid and syenite rocks make the best block pavements. These materials, cut with care, make excellent paving blocks, with which it is possible to lay an almost even wearing surface,as on certain streets of Berlin and Liverpool. About 1886, Fifth avenue, and since 1890, Broadway, and several other streets have been paved with very fair, although not yet the best, granite block pavements.

Paving blocks should not be too large. They must be set near together, with joints filled with gravel and paving pitch.

SPECIFICATIONS MADE PUBLIC.

Specifications of details of laying asphalt, granite block and other pavements can be had upon application at the Department of Public Works or the City Engineer of almost every city. These specifications are now quite complete. A great difficulty lies in compelling actual construction to be as specified. If citizens interested in paving were familiar with the general principles of good street paving, they would be of indirect assistance to the officials in charge of

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the pavements. Our newspapers and other press could do no more patriotic work than repeatedly instructing the public what good pavements are and how laid.

It is not for the engineer to discuss other than the technical reasons why some cities have poor pavements. It is his duty to point out what materials are good and how best used; how the curb should be properly set; what form of rails and other street equipments are good and efficient. In many American cities, I am sorry to say, other than technical influences are sometimes at work which prevent the best materials being used and in the best manner. In New York and several other cities we have at last arrived at the best materials, and theoretically provide in our specifications that they be used in the best manner.

EDUCATING THE PUBLIC TO GOOD PAVEMENTS.

An educated public knowing that good pavements exist will finally demand and enjoy such pavements.

This is especially illustrated in New York by the pavements introduced within the past few years. The public compares them with the poor pavements elsewhere in the city, and clamors for more good ones.

ASPHALT PAVEMENTS.

The excellent asphalt pavements, which, after use for many years in Europe, and in Washington and many other cities of the United States, were finally introduced into New York City, have effected a transformation. Asphalt is a form of wearing surface, which laid upon a concrete, prepared old stone block or other suitable foundation, produces results approximating closely to the definition of a perfect pavement. It is suited to most parts of the city. It is indispensable on certain streets; in the rich districts for luxury, in the tenement districts for health.

Asphalt pavements, in addition to being themselves agreeable, quiet and efficient, have brought about the following results, due to the unavoidable contrasts between them and other pavements:

Pavements of other materials are now laid on concrete foundations and with a more even general surface than heretofore.

Asphalt pavements have made life pleasanter, not only on the streets paved with this material, but upon streets now better paved with other materials.

Asphalt pavements being so easily cleaned, give satisfaction to the Street Cleaning Department and the citizens,

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and compel other pavements to be better cleaned or suffer by comparison.

Asphalt pavements have increased the value of property, causing real estate to sell and rent more easily, generally at higher rates.

A test of their popularity is that they are being constantly petitioned for in preference to other pavements.

Finally, it has inaugurated a change in the reputation of New York streets, which were spoken of as the worst paved and poorest cleaned of any metropolis of civilized nations. The asphalt pavements, in conjunction with the improved granite block pavements, are now so widely extended, that New York City promises to become one of the best paved and cleanest cities in the world.

It is interesting to learn that asphalt pavements were introduced into Lyons, France, about 1834, and Paris in 1854. They spread rapidly to London in 1869, Dresden and Hamburg 1872, Berlin 1873, a city larger than New York, and almost entirely paved with this material. Other cities of Europe soon followed.

American cities desired a smooth, quiet and sanitary pavement. Washington began in 1876 to use asphalt. It has now spread to seventy-two American cities.

The basis of almost all the asphalt pavement used in America is sand, cemented together by some suitable asphalt, generally from the asphalt lake on the Island of Trinidad.

The asphaltic limestone pavement, very little used in America, has been supplanted by this sand-asphalt compound.

The limestone became polished and slippery, whereas the sand mixture does not.

The success of asphalt pavement, in addition to approximating closely to a perfect pavement, is in a large measure due to the ease and rapidity with which it can be maintained in constant order, without interruption of traffic, inconvenience to the public or detriment to business.

EFFECT OF STREET RAILS ON PAVEMENTS.

It would be unjust to my hearers and to the subject, if I omitted a brief reference to street rails and their evil effects upon pavements. The public, the press, city officials and all paving contractors should unite in securing for our large cities a flat, *grooved rail.* The centre and side-bearing rails which now encumber our streets are a great injury to the pavements adjacent to them. Wooden stringers and ties

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should be abolished. Every European city, years ago, and Washington lately compelled grooved rails to be laid, similar to those lately placed on Broadway.

A comparison of the Broadway rail and its adjacent pavement with the West Street rail and pavement tells its own story. Both pavements are of the same materials, laid at about the same time. The West Street side-bearing rail has caused the ruin of the pavement of that street.

Grooved rails distribute the traffic and make it possible to maintain the pavement with an even surface and properly clean it.

It is, in the end, of advantage to street railway corporations to use grooved street rails set in concrete. The progress of their cars is facilitated because the street traffic does not seek the rails. The maintenance of track and adjacent pavement, at the cost of the railway company and others, is reduced to a minimum.

The French School of Engineers has correctly taught us that "economical maintenance and not cheap prime cost is the truest economy for all public work." It is the best rule to apply to pavements and to rails.

CO-OPERATION PRODUCES GOOD RESULTS.

Co-operation is the thought with which I shall close. Co-operation is the secret of most of the successes of men. The old adage applies: "God made men, not man, that they might help each other."

Many American cities, more so than New York, suffer from a lack of co-operation between the paving, sewer, water, lighting, cleaning, health, police, school and other divisions of the administration of the city, and the care of its material, mental and moral welfare. These departments are divisions of one great cause, namely, creating and maintaining a successful city with thousands of human bodies and souls and all they need.

If all the officials, engineers, professional and trained men of each city government had a system of co-operation, sustained by periodical conferences, as at Paris, Berlin and Washington we would be highly pleased with the results. The administration of our cities would do us more honor.

Fault must not be found so much with our individual officials, as with the system, or lack of system, under which our slow progress in municipal matters is made. I admire the progress we are making in paving as in other public work, and expect more and more with increasing rapidity, from year to year.

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